

I claim:

1. A reagent injector for treating a liquid, comprising:

A. an integral, solid housing having an exterior wall and a liquid inlet end and a liquid outlet end, a first conduit for liquid extending through the solid interior of said housing from its inlet end to its outlet end, a second conduit for liquid that has been injected with reagent extending through the solid interior of said housing from its inlet end to its outlet end, said first and second conduits being separated from each other in said solid housing so as to provide separated liquid flow channels through the interior of said housing with the liquid flowing in the same general direction through the separated channels, said first conduit having a first liquid inlet port at said inlet end of said housing and a discharge port for liquid without said reagent at said outlet end of said housing, a first valve seat in said first conduit between said first liquid inlet port and said discharge port for liquid without said reagent, said second conduit having a second liquid inlet port at said inlet end of said housing and a discharge port for liquid injected with reagent at said outlet end of said housing, said second conduit having a constricted portion between said second liquid inlet port and said discharge port for liquid injected with reagent that defines a venturi therein, an aperture through said exterior wall of said housing located at said constricted portion for entry of said reagent drawn in by said venturi that is entrained into the liquid passing through said second conduit, and there being a locator recess in said outlet end of said housing;

B. a removable first valve closure assembly comprising a first valve closure member sized to mate with said first valve seat and a first spring urging said first valve closure member toward said first valve seat in a direction opposite to the flow direction of liquid in said

first conduit, a removable first valve positioner containing said first valve closure member and said first spring that locates said first spring and said first valve closure member in said first conduit;

C. a removable flow control end cap having a plurality of outlet conduits to which liquid flowing out of said liquid discharge port for liquid injected with reagent and said discharge port for liquid without said reagent are directed, an abutment extending into one of said outlet conduits, and an end cap locator protruding beyond said end cap at a predetermined location, said end cap locator being inserted into said locator recess in said outlet end of said housing so as to align said liquid discharge port for liquid injected with reagent and said liquid discharge port for liquid without said reagent with predetermined outlet conduits in said end cap and to place said abutment into contact with said first valve positioner to hold said first valve positioner in said first conduit against the flow of liquid in said first conduit; and

D. means for removably attaching said flow control end cap to said outlet end of said housing.

2. The reagent injector for treating a liquid defined in claim 1, further comprising, said flow control end cap having external threads circumscribing one of its ends, said means for removably attaching said flow control end cap comprising a rotatable ring encircling said outlet end of said housing, said ring having internal threads that mate with said external threads on said end cap, a gasket between said one end of said end cap and said outlet end of said housing, and engagement of said threads and rotation of said ring removably attaching said second valve assembly to said housing.

3. The reagent injector for treating a liquid defined in claim 2, further comprising, an outwardly projecting peripheral rim on said housing, an inwardly projecting circumferential ledge on said ring,

said ledge bearing against said rim so that rotation of said ring draws said one end of said end cap toward said outlet end of said housing and compresses said gasket therebetween.

4. The reagent injector for treating a liquid defined in claim 1, further comprising, said means for removably attaching said end cap comprising a circular first peripheral rim on said outlet end of said housing that circumscribes and extends beyond said housing, a circular second peripheral rim on said end cap that circumscribes and extends beyond said end cap, said first and second rims having flat abutting faces, a gasket between said abutting faces, and a plurality of threaded fasteners securing said rims together so as to compress said gasket therebetween.

5. The reagent injector for treating a liquid defined in claim 1, further comprising, said first positioner being a first hollow cylinder having a cylindrical center cavity, said first spring being a first coil compression spring located in said center cavity, said first valve closure member having a cylindrical stem inserted into said first positioner and a shoulder located outside of said first positioner, one end of said first coil spring bearing against an inside end of said first positioner, and an opposite end of said first coil spring bearing against an end of said first valve closure member inside of said first positioner, said first positioner having a diameter less than that of said first conduit, radial fins on said first positioner holding said first positioner in the center of said first conduit so that liquid in said first conduit can flow around said first positioner.

6. The reagent injector for treating a liquid defined in claim 1, further comprising, said first and second conduits being circular in cross section, said locator recess being curved and said protruding end cap locator having a curvature complimentary to the curvature of said locator recess, a second valve seat in said discharge port for liquid injected with reagent of said second conduit, said end cap

comprising a removable second valve closure assembly for said second valve seat comprising a second valve closure member sized to mate with said second valve seat, and a second spring urging said second valve closure member toward said second seat in a direction opposite to the direction of liquid flow through said second conduit, said end cap having a collection conduit for combining the liquid that has flowed through said first and second conduits, a pressure relief outlet in said end cap, a pressure relief port between said collection conduit and said pressure relief outlet, a third valve seat in said pressure relief port, a removable third valve closure assembly within said end cap comprising a third valve closure member sized to mate with said pressure relief port, a third spring urging said third valve closure member toward said third valve seat, and a removable second positioner containing said third valve closure member and said third spring that holds said third spring and said third valve closure member within said end cap, and means for removably attaching said third valve closure assembly to said end cap.

7. The reagent injector for treating a liquid defined in claim 1, wherein said end cap comprises an untreated water supply inlet conduit, a liquid conduit hydraulically connecting said discharge port of said second conduit to said water supply inlet conduit, a drain conduit hydraulically connected to said discharge port for liquid without reagent of said first conduit.

8. A water aerator, comprising:

A. an integral, housing having an exterior wall and an unaerated water inlet end and an aerated water outlet end, a first conduit for unaerated water extending through the interior of said housing from its inlet end to its outlet end, a second conduit for water that is entrained with air extending through the interior of said housing from its inlet end to its outlet end, said first conduit

having a first water inlet port and an unaerated water discharge port, a first valve seat in said first conduit, said second conduit having a second water inlet port and an aerated water discharge port, said second conduit having a constricted portion between said second water inlet port and said aerated water discharge port that defines a venturi thereinside, an aperture through said exterior wall of said housing located at said constricted portion for entry of atmospheric air that is entrained into the water passing through said second conduit, a second valve seat in said aerated water discharge port,

B. a first valve closure member in said housing that is sized to mate with said first valve seat and a first spring urging said first valve closure member toward said first valve seat;

C. a removable end cap having a valve closure assembly for said second valve seat comprising a second valve closure member sized to mate with said second valve seat, a second spring urging said second valve closure member toward said second seat in a direction opposite to the aerated water flow through said second conduit, said end cap having a collection conduit for combining the water that has flowed through said first and second conduits, a pressure relief outlet in said end cap, a pressure relief port between said collection conduit and said pressure relief outlet, a third valve seat in said pressure relief port, a third valve closure member sized to mate with said pressure relief port in said end cap, a third spring urging said third valve closure member toward said third valve seat; and

D. means for removably attaching said end cap to said outlet end of said housing.

9. The water aerator defined in claim 8, further comprising, means for removably attaching said third valve closure assembly to said second valve closure assembly, and an abutment extending into

said collection conduit holding said first valve closure member in said first conduit.

10. The water aerator defined in claim 9, further comprising, a locator pin protruding beyond said end cap at a predetermined location, there being a locator opening in said housing at its outlet end, so that insertion of said locator pin into said opening positions said second valve closure member in said second valve seat, and positions said abutment in said collection conduit against an end of said first valve closure member.

11. The water aerator defined in claim 8, further comprising, a removable hollow cylindrical first positioner having a cylindrical first center cavity, said first spring being a first coil compression spring located in said first center cavity, said first valve closure member having a cylindrical stem inserted into said first positioner and a shoulder located outside of said first positioner, one end of said first coil spring bearing against an inside end of said first positioner, and an opposite end of said first coil spring bearing against an end of said stem, said first positioner having a diameter less than that of said first conduit so that liquid in said first conduit can flow around said first positioner, a removable hollow cylindrical second positioner having a cylindrical second center cavity, said third spring being a third coil compression spring located in said second center cavity, said third valve closure member having a cylindrical stem inserted into said third coil spring and a shoulder located outside of said second positioner, one end of said third coil spring bearing against an inside end of said second positioner, and an opposite end of said third coil spring bearing against said shoulder of said third valve closure member.

12. A water aerator, comprising:

A. an integral, housing having an exterior wall and a water inlet end and an aerated water outlet end, a first conduit for

unaerated water extending through the interior of said housing from its inlet end to its outlet end, a second conduit for water that is entrained with air extending through the interior of said housing from its inlet end to its outlet end, said first and second conduits being separated from each other in said housing so as to provide separated water flow channels through the interior of said housing with the water flowing in the same general direction through the separated channels, said first conduit having a first water inlet port at said inlet end of said housing and an unaerated water discharge port at said outlet end of said housing, a first valve seat in said first conduit between said first water inlet port and said unaerated water discharge port, said second conduit having a second water inlet port at said inlet end of said housing and an aerated water discharge port at said outlet end of said housing, said second conduit having a constricted portion between said second water inlet port and said aerated water discharge port that defines a venturi there inside, an aperture through said exterior wall of said housing located at said constricted portion for entry of atmospheric air that is entrained into the water passing through said second conduit, a second valve seat in said aerated water discharge port,

B. a first valve closure member in said first conduit that is sized to mate with said first valve seat and a first spring urging said first valve closure member toward said first valve seat in a direction opposite to the flow direction of water in said first conduit;

C. a removable end cap having a valve closure assembly for said second valve seat comprising a second valve closure member sized to mate with said second valve seat, a second spring urging said second valve closure member toward said second seat in a direction opposite to the direction of aerated water flow through said second conduit, said second valve closure assembly having a collection conduit for combining the water that has flowed through said first

and second conduits, a pressure relief outlet in said valve closure assembly, a pressure relief port between said collection conduit and said pressure relief outlet, a third valve seat in said pressure relief port, a third valve closure member sized to mate with said pressure relief port, a third spring urging said third valve closure member toward said third valve seat; and

D. means for removably attaching said external valve closure assembly to said outlet end of said housing.

13. The water aerator defined in claim 12, further comprising, means for removably attaching said third valve closure member to said end cap, and an abutment extending into said collection conduit holding said first valve closure member in said first conduit.

14. The water aerator defined in claim 13, further comprising, a locator pin protruding beyond said end cap at a predetermined location, there being a locator opening in said housing at its outlet end, so that insertion of said locator pin into said opening positions said second valve closure member in said second valve seat, and positions said abutment in said collection conduit against an end of said first valve closure member.

15. The water aerator defined in claim 12, further comprising, a removable hollow cylindrical first valve positioner having a cylindrical first center cavity, said first spring being a first coil compression spring located in said first center cavity, said first valve closure member having a cylindrical stem inserted into said first positioner and a shoulder located outside of said first positioner, one end of said first coil spring bearing against an inside end of said first valve positioner, and an opposite end of said first coil spring bearing against said stem of said first valve closure member, a removable hollow cylindrical second valve positioner having a cylindrical second center cavity, said third spring being a third coil compression spring located in said second center cavity,



said third valve closure member having a cylindrical stem inserted into said third coil spring and a shoulder located outside of said second positioner, one end of said third coil spring bearing against an inside end of said second positioner, and an opposite end of said third coil spring bearing against said shoulder of said third valve closure member.

16. An adjustable potable water aerator, comprising:

A. an integral, housing having an exterior wall and a water inlet end and an aerated water outlet end, a first conduit for unaerated water extending through the interior of said housing from its inlet end to its outlet end, a second conduit for water that is entrained with air extending through the interior of said housing from its inlet end to its outlet end, said first and second conduits being separated from each other inside of said housing so as to provide separated water flow channels through the interior of said housing with the water flowing in the same general direction through the separated channels, said first conduit having a first water inlet port at said inlet end of said housing and an unaerated water discharge port at said outlet end of said housing, a first valve seat in said first conduit between said first water inlet port and said unaerated water discharge port, said second conduit having a second water inlet port at said inlet end of said housing and an aerated water discharge port at said outlet end of said housing, said second conduit having a constricted portion between said second water inlet port and said aerated water discharge port that defines a venturi thereinside, an aperture through said exterior wall of said housing located at said constricted portion for entry of atmospheric air that is entrained into the water passing through said second conduit, a second valve seat in said aerated water discharge port,

B. a removable first valve closure assembly comprising a first valve closure member sized to mate with said first valve seat and a

first spring urging said first valve closure member toward said first valve seat in a direction opposite to the flow direction of water in said first conduit, a removable first positioner containing said first valve closure member and said first spring that locates said first spring and said first valve closure member in said first conduit;

C. a removable end cap having a second valve closure assembly for said second valve seat comprising a second valve closure member sized to mate with said second valve seat, a second spring urging said second valve closure member toward said second seat in a direction opposite to the direction of aerated water flow through said second conduit, said end cap having a collection conduit for combining the water that has flowed through said first and second conduits, a pressure relief outlet in said end cap, a pressure relief port between said collection conduit and said pressure relief outlet, a third valve seat in said pressure relief port, a removable third valve closure assembly within said end cap comprising a third valve closure member sized to mate with said pressure relief port, a third spring urging said third valve closure member toward said third valve seat, a removable second positioner containing said third valve closure member and said third spring that holds said third spring and said third valve closure member within end cap, means for removably attaching said third valve closure assembly to end cap, and means spanning said collection conduit holding said first removable positioner in said first conduit; and

D. means for removably attaching said end cap to said outlet end of said housing.

17. The potable water aerator defined in claim 16, further comprising, a locator pin protruding beyond said second valve closure assembly at a predetermined location, there being a locator opening in said housing at its outlet end, so that insertion of said locator pin into said opening positions said second valve closure

member in said second valve seat, and positions said third valve closure member in said third valve seat, and positions said abutment in said collection conduit against an end of said first positioner.

18. The potable water aerator defined in claim 16, further comprising, said first positioner having a cylindrical first center cavity, said first spring being a first coil compression spring located in said first center cavity, said first valve closure member having a cylindrical stem inserted into said first positioner and a shoulder located outside of said first positioner, one end of said first coil spring bearing against an inside end of said first positioner, and an opposite end of said first coil spring bearing against said stem of said first valve closure member, said second positioner having a cylindrical second center cavity, said third spring being a third coil compression spring located in said second center cavity, said third valve closure member having a cylindrical stem inserted into said third coil spring and a shoulder located outside of said second positioner, one end of said third coil spring bearing against an inside end of said second positioner, and an opposite end of said third coil spring bearing against said shoulder of said third valve closure member.

19. A aqueous concentrate aerator, comprising:

A. an integral, housing having an exterior wall and a aqueous concentrate inlet end and an aerated aqueous concentrate outlet end, a partition inside of said housing extending through said housing and dividing said housing into a first conduit for unaerated aqueous concentrate and a second conduit for aqueous concentrate that is entrained with air, said first and second conduits being separated from each other by said partition so as to provide separated aqueous concentrate flow channels through the interior of said housing with the aqueous concentrate flowing in the same

general direction through the separated channels, said first conduit having a first aqueous concentrate inlet port at said inlet end of said housing and an unaerated aqueous concentrate discharge port at said outlet end of said housing, a back pressure drain valve seat in said first conduit between said first aqueous concentrate inlet port and said unaerated aqueous concentrate discharge port, said second conduit having a second aqueous concentrate inlet port at said inlet end of said housing and an aerated aqueous concentrate discharge port at said outlet end of said housing, said second conduit having a constricted portion between said second aqueous concentrate inlet port and said aerated aqueous concentrate discharge port that defines a venturi therein, an aperture through said exterior wall of said housing located at said constricted portion for entry of atmospheric air that is entrained into the aqueous concentrate passing through said second conduit;

B. a removable valve closure assembly comprising a valve closure member sized to mate with said back pressure drain valve seat and a spring urging said valve closure member toward said back pressure drain valve seat in a direction opposite to the flow direction of aqueous concentrate in said first conduit, a removable valve positioner containing said valve closure member and said spring that locates said spring and said valve closure member in said first conduit;

C. a removable flow control end cap comprising an untreated water supply inlet conduit, an aerated aqueous concentrate conduit hydraulically connecting said discharge port of said second conduit to said water supply inlet conduit, a drain conduit hydraulically connected to said discharge port of said first conduit; and

D. means for removably attaching said removable flow control assembly to said outlet end of said housing.

20. The aqueous concentrate aerator defined in claim 19, further comprising: said removable flow control end cap comprising an abutment extending into said drain conduit that locates and holds said valve positioner in said first conduit by bearing against an exterior end of said valve positioner.

21. The aqueous concentrate aerator defined in claim 20, further comprising: a hollow end cap locator protruding beyond said flow control end cap at a predetermined location, there being a locator opening in said housing at its outlet end, so that insertion of said end cap locator into said opening positions said first valve closure member in said back pressure drain valve seat, and positions aerated aqueous concentrate conduit in alignment with said discharge port of said second conduit, and positions said abutment in said collection conduit against said end of said valve positioner.

22. The aqueous concentrate aerator defined in claim 19, further comprising: said removable valve positioner comprising a hollow cylinder having a cylindrical center cavity, said spring being a coil compression spring located in said center cavity, said valve closure member having a cylindrical stem inserted into said coil spring and a shoulder located outside of said positioner, one end of said coil spring bearing against an inside end of said positioner, and an opposite end of said coil spring bearing against said shoulder of said valve closure member.

23. The aqueous concentrate aerator defined in claim 19, further comprising: flow control means between said aqueous concentrate inlet port of said first conduit and said drain conduit of said end cap.